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ABSTRACT

This report suggests that research in education, as well as the design of instruction, can be importantly influenced by the paradigm that guides the work. The application of a paradigm to educational research is illustrated, and two paradigms (reception learning and discovery learning) are contrasted. Finally, it is suggested that all educational research be guided by some paradigm, for ultimately all paradigms are modified or discarded. The issue is not whether the paradigm is true but whether it is useful. Special emphasis is given to the paradigm for reception learning, especially that of Ausubel. (Author/BB)

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The Reception Learning Paradigm *

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Introduction

For some two decades my colleagues and I have pursued the question: Can education be a rational enterprise? We have defined a rational enterprise as one that involves the invention of theories and concepts that predict reliably regularities in the world around us, regularities that are real or constructed (as in mathematics). A rational enterprise is also one which employs methods to modify theories or concepts, as Toulmin (1972) has explained. In recent years, we have become increasingly convinced that the answer to our basic question is yes, and we have been proceeding to elaborate an educational theory and concepts that can be functional and to obtain empirical evidence to support and/or modify the theory and concepts. The outcome of this work is summarized in a recent book, A Theory of Education (Novak, 1977).

More recently, Gowin (1978) has suggested a useful heuristic device for viewing the nature of any rational, knowledge making enterprise. We have come to refer to this as Gowin's Epistemological V, shown in figure 1. The "basic point" of the V is that a rational enterprise always begins with a study of objects or events. Objects are anything we can observe and events are anything that happens or can be made to happen. The primary achievement of a rational enterprise is the invention of concepts. Gowin defines concepts as regularities in events or objects designated by some sign or symbol. Dog, for example, is the sign English speaking people use to designate the variety of living things that have four legs, a tail and bark. Truth is a more elusive regularity to define, but we all have a

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functional meaning for this concept label, albeit jurors may debate at length on what is the truth in a given litigation. Records we will define as what we note when we observe objects or events.

One aspect of genius is to select what objects or events are of interest to observe and what kind of records to make. So it was Mendel's genius that enabled him to select peaflower, color, height, etc. to observe and to record the frequency of these traits in progeny, and Watson and Crick's genius led them to construct alternative molecular models for DNA. The product of such genius is new concepts (new regularities) such as Mendel's factors and Watson and Crick's double helix. New concepts lead to new ways to observe old objects or events and new ways to select new objects or events worthy of scrutinizing and recording. New concepts also give new ways to observe, record or transform records (e.g. R. A. Fisher's t statistic).

An Epistemology for Education

We can use Gowin's V as a tool to study the nature of knowledge and knowledge production in education. This assumes, of course, that we consider education to be a rational enterprise, and that we hold a philosophical view that the study of educational objects or events can be rationally conceptualized, as suggested in figure 2. Many teachers and "professional" educators tacitly operate as though education occurs by some mysterious force and their educational epistemology is no more related to rational disciplines than astrology is related to science. If Gowin's V has some validity, we should find it possible to use this heuristic to examine the process of knowledge making in education.

In figure 2 I have suggested some of the elements that should be

considered under the general theory of reception learning, with special reference to mastery learning (See Bloom, 1968, 1976). The events under study are the interplay between learning modules, pretests for knowledge of physics, intuitive and analytic ability and criterion-reference tests for achievement on study modules. Sample data transformations and knowledge claims would be as shown in figure 2, and also a sample value claim. The research "mapped" on to the "V" in figure 2 would be studies of the type reported earlier (Thorsland and Novak, 1974; Naegele, 1974; Castaldi, 1975).

Reception Learning as Theory for School Learning and Instruction

The label "reception learning" has been given a variety of interpretations, so for the purposes of this paper, I will define reception learning as that form of learning where the regularities to be learned and their concept labels are presented explicitly to the learner. In contrast, discovery learning in its pure form requires that the regularities in objects and/or events are first discovered by the learner, abstracted from the general context in which they occur and perhaps given a concept label, although the latter is not part of discovery learning per se. In actual practice, discovery learning occurs primarily with very young children in the process of concept formation, as when children discover that all things with four legs, tail and bark are called dogs by older persons, or when new discoveries are made. Most discovery learning in school settings is actually various levels of guided discovery learning, and we have a continuum from a pure reception mode of learning to pure discovery mode of learning.

However, we must also consider the cognitive functioning and psychological set of the learner as new knowledge is internalized. Here we must distinguish between rote learning wherein new knowledge is arbitrarily

incorporated into cognitive structure in contrast to meaningful learning wherein new knowledge is assimilated into specifically relevant existing concepts or propositions in cognitive structure. Since the nature and degree of differentiation of relevant concepts and propositions varies greatly from learner to learner, it follows that the extent of meaningful learning also varies along a continuum from almost pure rote to highly meaningful. Figure 3 schematizes the rote ↔ meaningful learning continuum as distinct from the reception ↔ discovery mode of information acquisition. A clear distinction between these two continua has been one of the important contributions of David Ausubel's (1968, 1978) learning psychology. Description of the major elements of his theory go beyond the scope of this paper and can be found elsewhere (Novak, Ring and Tamir, 1971; Novak, 1977a, 1977b). Some of the key elements of his theory as they relate to a paradigm for science education research are discussed below.

The use of Gowin's V to examine the epistemology underlying any educational inquiry is not dependent on the use of any specific theory. However, we cannot legitimately work in the framework of one theory and then invoke principles or concepts that are derivative from another theoretical framework. One of my criticisms (Novak, 1977a, pp. 125-128) of Gagne's learning model (1965, 1970) is that it derives from behaviorist theory that eschews consideration of concepts, and then proceeds to employ concepts from cognitive learning theory to explain concept learning, rule learning and problem solving. The eclectic who invokes whatever concepts are convenient on the "left side" of the V to explain what happens on the "right side" is building on epistemological quicksand.

Perhaps one of the most popular theories applied to education studies

today is the developmental psychology of Jean Piaget. One of the reasons for the success of Piaget's developmental theory is the power and consistency it has shown for critically observing selected educational events, guiding the record making (clinical interview) and record transforming processes and development of knowledge claims. The genius of Piaget has been analagous to that of Mendel who carefully selected traits to be observed, devised clever ways to record and transform data and showed the consistency between theory and evidence. Useful as Piaget's work has been, I have argued elsewhere (Novak, 1977a; 1977b) that there are alternative theoretical models that are more relevant to learning events and to a generally broader array of other educational events.

Information processing psychology, the most popular reception learning theory today, derives from earlier "cybernetic" (Smith and Smith, 1966) theories and is rapidly becoming embraced by many psychologists who previously were ardent behaviorists. The cybernetic learning theories had their origins in the early 1950's and have advanced in part through their identification with computer models for learning which have experienced tremendous impetus from the exponential rate of advance in computer technology. However, early pioneers such as Estes (1950) suggest caution in hoping for too much too soon from information processing theory (Estes, 1978, p. 6).

Though anyone's judgment at this point is necessarily speculative, my own is that the computer analogy has proven to have definite merits and has been of substantial value in the early stages of a new approach to cognitive psychology. But this analogy also has sharp limitations. In important ways it seems that the human brain and the computer operate on different principles (see, for example, Anderson, 1977). In some current theorizing by the most enchusiastic devotees of the

information-processing approach, we are beginning to see the results of trying to rely too strongly on an analogy of limited validity. But over the greater part of the field, we are seeing instead the emergence of new combinations of theoretical ideas and methods that may be considered inelegant in terms of the inhomogeneity of their origin but that are dictated by the demands of new findings.

While we hope that information processing theories as a basis for learning studies do not achieve the blatant dogmatic adherence that characterized behaviorist theories in the 1940's and 1950's, we would encourage careful study and consideration of this theoretical view as an alternative science education.

Ausubel's Assimilation Theory

Reception learning strategies have had a long history going back to the writings of early Greeks and Romans. However, David Ausubel was first to formulate a comprehensive theory relevant to a wide array of educational events. His Psychology of Meaningful Verbal Learning (1963) and later Educational Psychology: A Cognitive View (1968) set forth a system of concepts in a theoretical framework that has, in our view, powerful heuristic value for study of a wide array of educational events. Our research program has employed his theoretical views since 1964 (when we abandoned cybernetic theory) and we have found the theory very helpful in guiding the selection of educational events for study, types of assessment measure to use, alternative ways to transform data, and the interpretation of relevant knowledge claims. Some of our work has suggested modifications in Ausubel's theory and these are reflected in his more recent book (Ausubel, Novak and Hanesian, 1978).

Another important characteristic of Ausubel's learning theory is its

consistency with what we regard as key principles from modern epistemology, curriculum theory, and instructional theory. Firstly, meaningful learning, a key concept in Ausubel's theory, is dependent upon the idiosyncratic concepts individuals hold, which in turn are derived from the current concepts held in the society impinging on the individual. There is close harmony between the central role of concepts in current epistemologies and in Ausubel's description of the process of meaningful learning.

Secondly, Ausubel's description of "advance organizers" and their role in facilitation of meaningful learning, together with the emphasis on concept learning as the central learning task, is highly compatible with Johnson's (1967) model for curriculum. Johnson defines curriculum as an ordered sequence of intended learning outcomes (ILO's) where the major ILO's are the concepts the teacher selects from the discipline under study. Johnson's distinction between curriculum and instruction, where the latter invokes selection of specific examples or activities designed to achieve the ILO's of the curriculum, nicely complements the emphasis in Ausubel's theory summarized as:

If I had to reduce all of educational psychology to just one principle, I would say this: The most important single factor influencing learning is what the learner already knows. Ascertain this and teach him accordingly.

The challenge of the instructional designer is to select examples or activities that will allow the learners to assimilate new concepts to be learned (or new elaboration) into the idiosyncratic conceptual framework they already have.

Thirdly, Ausubel's theory supports and elaborates some of the concepts in Carroll's (1963) model for school learning, later elaborated by Bloom (1968) in his ideas on mastery learning and Bloom's research findings

reported more recently (1976). Although Ausubel recognizes important genetic differences in learning capability, the quote above points out that careful consideration of the "anchoring" concepts a learner has will influence the rate and quality of meaningful learning. Carroll and Bloom's view that most students can master most school subject matter if they are guided and given time to master relevant concepts necessary for later learning is explainable through Ausubel's learning concepts on the nature and role of advance organizers, progressive differentiation of concepts and integrative reconciliation of concepts.

Finally, there is also the affective domain to be considered and here Ausubel's theory provides important guidance in the positive affective results that accrue from competence or achievement motivation that derives from successful meaningful learning. While other factors also influence positive affective growth, the primary avenue through which schools can contribute, he would contend, is through encouragement of practices that augment meaningful learning.

In summary, I have tried to show that research in education, as well as the design of instruction, can be importantly influenced by the paradigm that guides our work. As Kuhn (1962) points out and Lakatos (1976) better elaborates, advances in a discipline arise from systematically employing a paradigm to guide our work and there are at any time competing paradigms. The crucial factor is that we are guided in our work by some paradigm, for ultimately all paradigms are modified or discarded and the issue is not whether our guiding paradigm is true but whether it is useful. My contention is that a paradigm for reception learning, especially that of Ausubel can be enormously useful to science education.

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GOWIN'S EPISTEMOLOGICAL V

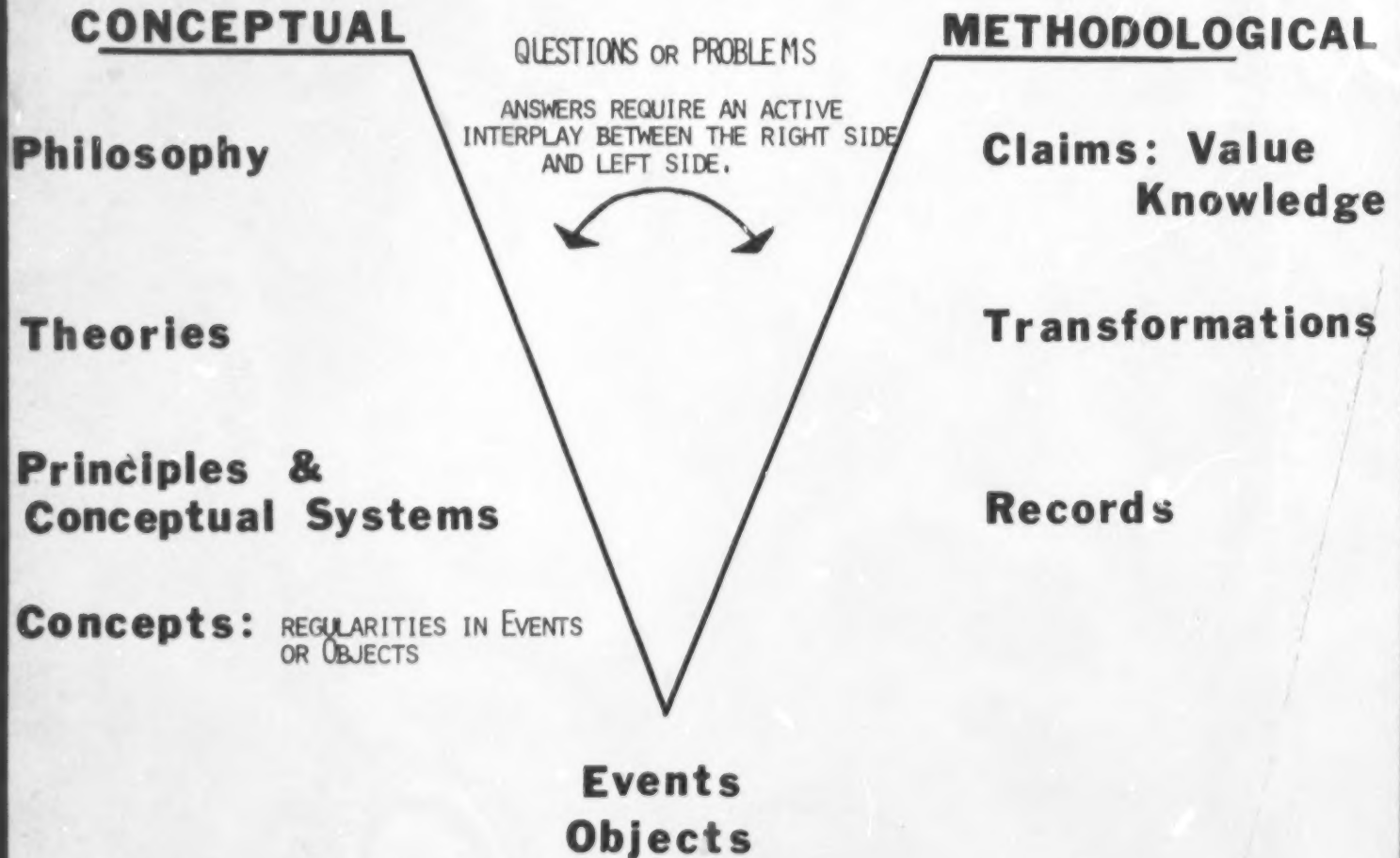


FIGURE 1. Gowin's (1978) Epistemological V can be used as a heuristic for viewing the nature of science for the science of education.

A SAMPLE EPISTEMOLOGICAL V FOR EDUCATION

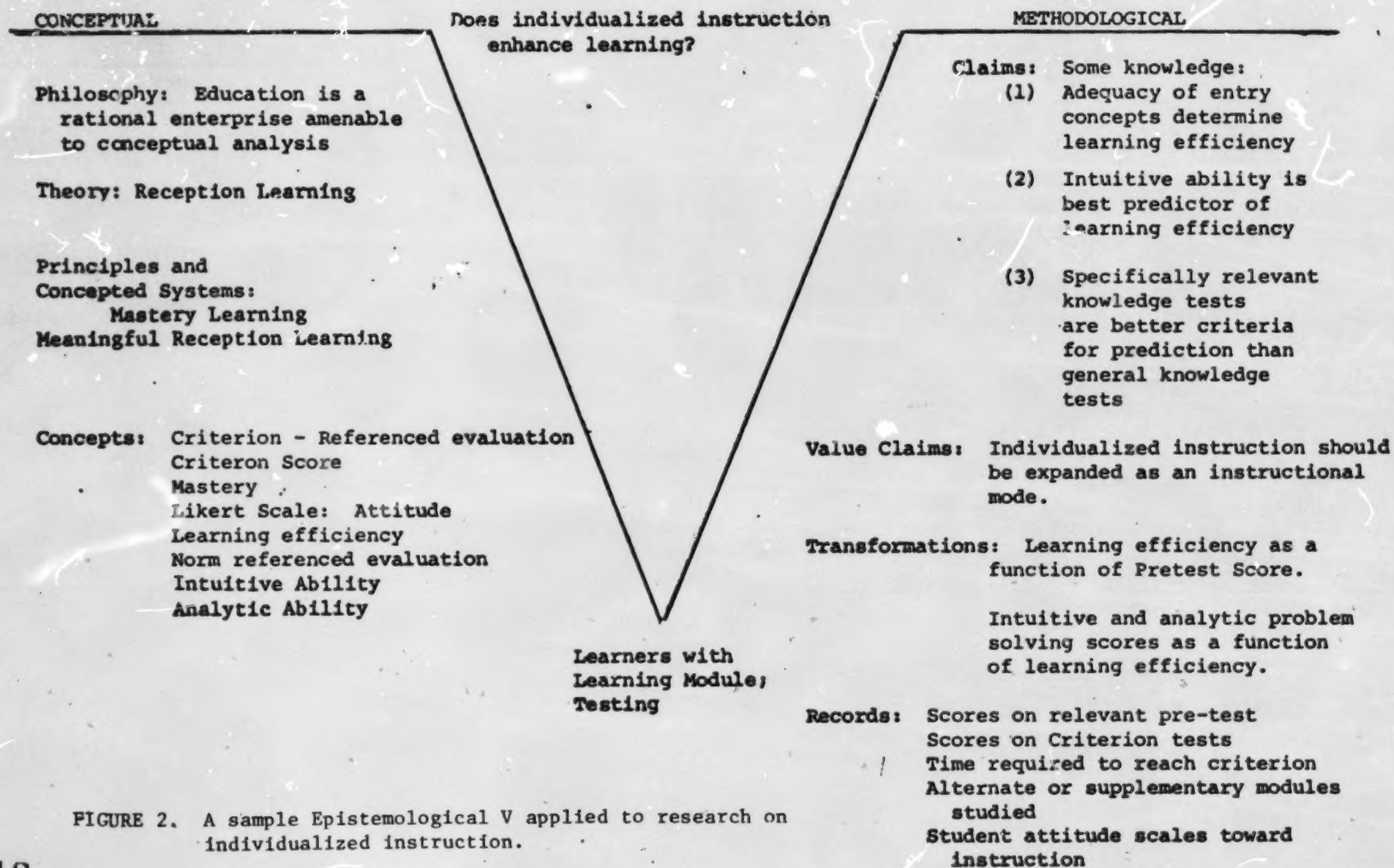


FIGURE 2. A sample Epistemological V applied to research on individualized instruction.

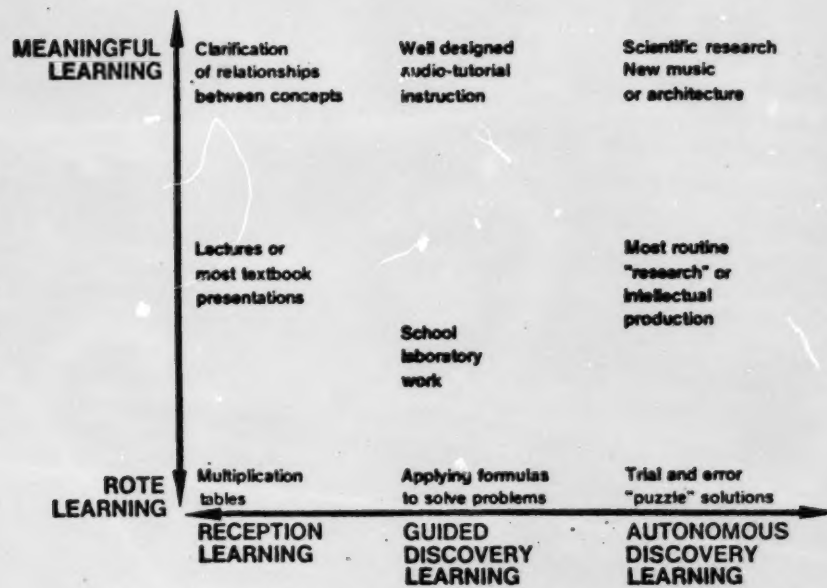


Figure 3. The rote-meaningful, reception-discovery learning continuums.